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Anastomosis Between *Ulnar* and Radial Nerve, a Cadaveric Study

ORIGINAL

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Abstract

Background: Brachial plexus variations are not rare. Variations in its terminal branches in the arm or forearm are frequently reported. Communications between branches of the brachial plexus are also not uncommon findings; however there is very little mention of communication between the radial and *ulnar* nerves in the literature. In view of this significance is performed this study with the purpose to determine any communications of radial nerve with neighboring peripheral nerves at level of axilla, arm, forearm.

Methods and Findings: A total of 17 cadavers with different age groups were used for this study. The upper limbs region (34 sides) were dissected carefully and photographed in the Morphology Laboratory at the University of Pamplona. Of the 34 upper limbs studied 33 showed normal morphology, the course and branching patterns of the nerves were normal (97.06%). In 1 specimen in the left forearm (2.94%), the radial and *ulnar* nerves were dissected and communicating branches were observed originating near the upper third in the posterior aspect of the forearm traveling from the *ulnar* to the radial nerve. The communicating branch was approximately 5.84 cm long and 1.73 mm in diameter. This anastomotic branch is an unusual anastomosis, no described in the literature between radial and *ulnar* nerve in forearm. Knowledge on the variant pattern of peripheral nerves is imperative not only for the surgeons, but also for the radiologists during image technology and MRI interpretations and for the anesthesiologists before administering anesthetic agents thus in diagnostic approaches, in neurophysiology studies.

Conclusions: Lack of understanding of these variations can also confound the assessment of the severity of nerve injury as well as recovery. Awareness of such anatomical variations is very important in order to proper diagnosis of sensorimotor symptoms.

Keywords
Anatomical Variation; *Ulnar* Nerve; Radial Nerve; Unusual Anastomosis; Clinical Implications.

Introduction

Brachial plexus is a major nerve plexus of the upper limb. Among the branches of the brachial plexus, the

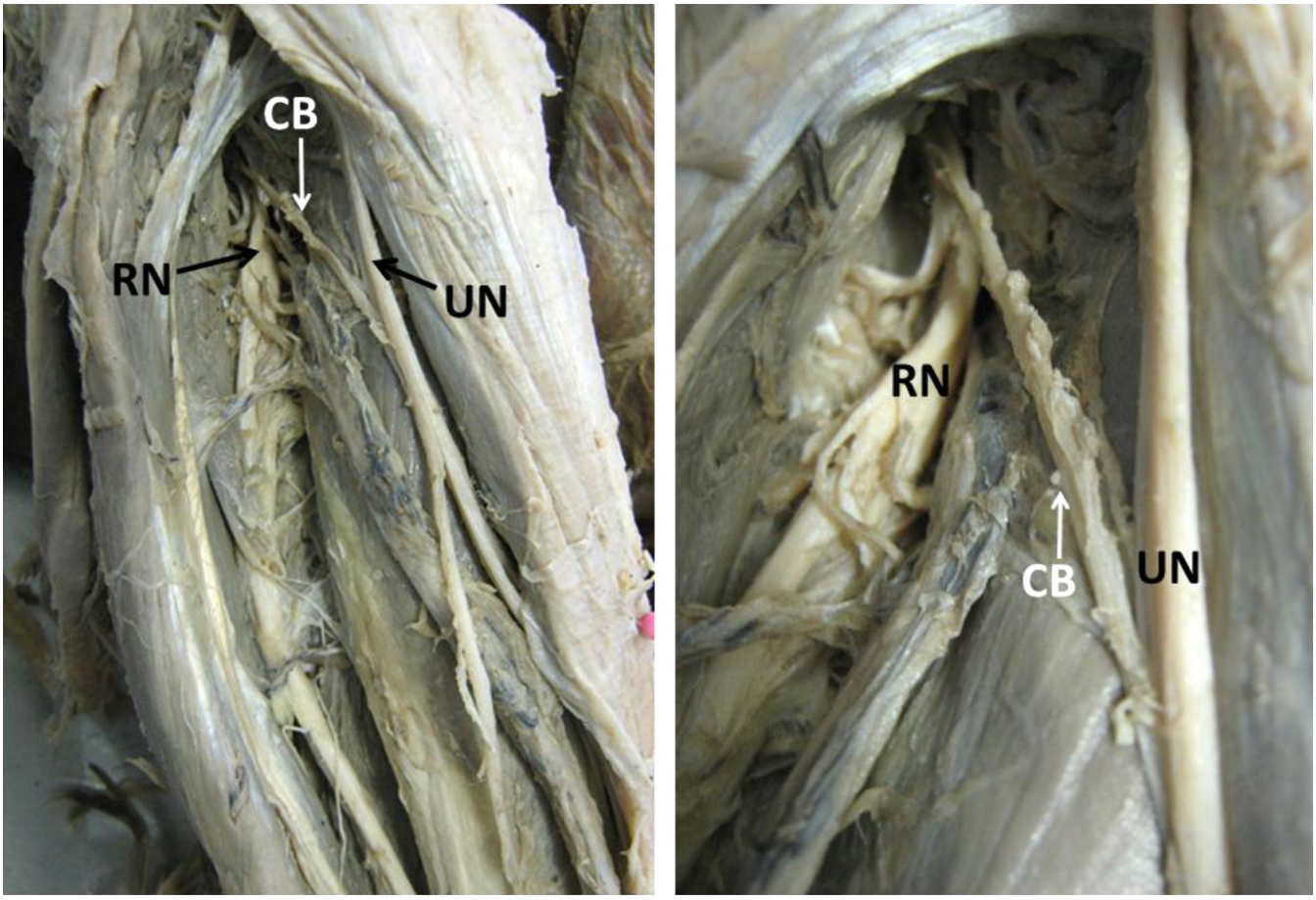
median, *ulnar*, and radial nerve provide chief contribution in terms of sensory and motor innervation to upper limb structures. Following their formations from respective cords of brachial plexus, they lie in close relation to the *axillary* artery. The posterior cord of brachial plexus gives rise to radial nerve which passes through the lower triangular space of scapular region and then through radial groove along with the *profunda brachii artery* and gives branches to three heads of *triceps brachii* muscle, while the medial cord of the brachial plexus gives rise to ulnar nerve [1]. Brachial plexus lesions, or injuries, can occur as a result of shoulder tumors, trauma or inflammations and brachial plexus blockade carrying out in some surgical procedure on the upper limb like bone fractures, in patients with respiratory diseases such as: emphysema, bronchitis. For this purpose, a precise understanding of the anatomy of the plexus is necessary as well as recognition of anatomic variations that may occur [2].

The variation in the course, distribution, formation of the brachial plexus branches and the connections between terminal branches of the brachial plexus in the upper limb are common and have been reported, and some of them presented the percentage of the connection [3-7]. Variation in nerves with abnormal origin, distribution and course are usually more susceptible to entrapment neuropathies and iatrogenic injuries [2, 3, 5, 6]. Anomalous formations of brachial plexus and its unusual communications with neighboring nerves at axilla or at high humeral level are to be noted as it may present a complicating factor during surgical attempts to cause a nerve blockade. An unusual communication between neighboring nerves of the brachial plexus often causes blockade of unexpected areas. It has been noted that much variations in communications between neighboring nerves do exist either in the forearm (most commonly) or in the hand [8]. There are few studies like to present case, which were about anastomosis between ulnar and radial nerves, in previous reported, the anastomosis were sensorial and they were on the dorsal or palmar aspect of the hand [7, 9, 10]. The objective of the present cadaveric study to determine any communications of radial nerve with neighboring peripheral nerves at level of axilla, arm, forearm and discuss the clinical implications.

Methods

This work was previously approved by the Ethics Committee in Research and Environmental Impact of the University of Pamplona, conformed by resolution 030 of January 16 of 2014 and Resolution No. 008430 of 1993 of October 4 of the Ministry of Health of Republic of Colombia by which regulates the scientific, technical and administrative norms for health research. This descriptive cross-sectional study was designed to determine the prevalence of anastomosis between radial and ulnar nerve or radial nerve with neighboring peripheral nerves in 34 upper extremities of 15 male and 2 females embalmed adults cadavers in the laboratory of Morphology of the University of Pamplona. The upper limbs were studied serially during the years 2013-2016. The axillary region of all the limbs was exposed carefully after clearing the entire fascia and to look for the anatomy of ulnar nerve formation from medial cord of *brachial plexus*. The dissection was further continued towards the arm and forearm in order to probe any communications of radial nerve with neighboring peripheral nerves of these regions. Meticulous observation of variant forms and/or abnormal communication if any was made. Measurements were taken with assistance of a sliding Vernier caliper, accurate to 1 mm du-

Figure 1: Posterior view of left forearm showing the communicating branch between *ulnar* and radial nerves.



UN: *ulnar* nerve, RN: radial nerve, CB: communicating branch.

ring the course of the anatomical dissection. The data thus obtained were recorded in a physical matrix and were consigned in digital media using Excel tables. Topographic details of the variations were examined, recorded and photographed.

Results

Of the 34 upper limbs studied, 33 showed normal morphology, the course and branching patterns of the nerves was normal, having classic pattern of branching without communications as per described in the standard text book of anatomy (97.06%) of all upper limbs examined). The anatomical variation described was found during routine dissection performed by medical students of second semester in a male cadaver of 47-year-old in the left forearm (2.94%), the radial and *ulnar* nerves were dissected and communicating branches were observed originating near the upper third in the posterior aspect of the forearm traveling from the *ulnar* to the radial nerve. The communicating branch was approximately 5.84 cm long and 1.73 mm in diameter. **Figure 1**.

Discussions

The ontogenic explanation for the presence of such communication may be attributed to the random factors like altered signalling between the *mesenchymal cells* and the neuronal growth cones or the failure of differentiation as a cause for some of

the fibres taking an aberrant course as a communicating branch or these may be due to circulatory factors at the time of fusion of the brachial plexus cords [11]. Chiarapattanakom et al (1998) are of opinion that the limb muscles develop from the *mesenchyme* of local origin while axons of spinal nerves grow distally to reach the muscles or the skin. They blamed the lack of coordination between the formation of the limb muscles and their innervation for appearance of a communicating branch [11, 12]. Several studies have reported communications between terminal branches of brachial plexus in the forearm as well as in hand. Different terminology has been allotted to the existence of communication between median and ulnar nerve based on the location of their existence as *Riche-Cannieu* anastomosis in the palm, *Martin-Gruber* anastomosis and *Marinacci* communication in the forearm, and *Berrettini* anastomosis manifested by the communication between digital branches in the palm. *Ansa pectoralis* communication between the lateral and medial pectoral nerves [3, 5, 8]. There are several case reports in the literature that describe connections found in cadaveric specimens between the radial and ulnar nerves in the arm, high humeral level, at humeral level, mid humeral level, hand [13]. In addition, the *Froment–Rauber* nerve is a variant of the radial nerve where fibers from either the *posterior interosseus nerve* (PIN) or superficial radial nerve (SRN) provide motor innervation to the intrinsic hand muscles either directly or through communication with the *ulnar* nerve [13].

Investigations of peripheral neuropathies are based upon patterns of functional deficits and diagnostic testing. Therefore, an anatomical variation can often lead to confounding patterns of physical and diagnostic findings. Anatomical variant communication between branches of the brachial plexus could obscure the management of complex regional pain syndrome [8, 14]. *Ulnar* neuropathies are the most frequent causes of nerve injuries as reported by Kroll et al. and they account for a majority with a prevalence of 33%, which is followed by 23% of incidence cases by brachial plexus injuries [15]. Anatomical anomalies are one among the other major risk factors which could be attributed to this cause [3, 5, 16]. Ascertaining the presence of communicating branches may be of importance in the evaluation of inexplicable sensory loss resulting from trauma or iatrogenic injuries during surgical intervention in a particular area [17]. Therefore, knowledge on the variant pattern of peripheral nerves is imperative not only for the surgeons, but also for the radiologists during image technology and MRI interpretations and for the anesthesiologists before administering anesthetic agents thus in diagnostic approaches. Damage to communicating roots or nerve may result in weakness with the eventual difficulty in diagnosis [8, 18]. The motor communication between *ulnar* and radial nerve is seldom reported. The case presented in the present study is considered it as a rare variation has not been previously described. It is the first case reported so far in the available scientific literature.

Conclusion

The knowledge of communications between nerves is invaluable in clinical practice, especially in radiological diagnoses and surgical procedures. Anatomical Variation in nerves with abnormal origin, course, and distribution are usually more prone to iatrogenic injuries and entrapment neuropathies. It is often used in the explanation of non-classical clinical signs and symptoms as well as the severity of nerve injury as well as recovery. Knowledge about anatomical variations of the peripheral nerves is therefore important for the clinicians in neurophysiology studies.

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Competing interests

None

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